

### **Abstract of the Disclosure**

A apparatus 10,110,170 is provided that measures the speed of sound and/or vortical disturbances propagating in a single phase fluid flow and/or multiphase mixture to

5 determine parameters, such as mixture quality, particle size, vapor/mass ratio, liquid/vapor ratio, mass flow rate, enthalpy and volumetric flow rate of the flow in a pipe, by measuring acoustic and/or dynamic pressures. The apparatus includes a spatial array of unsteady pressure sensors 15 - 18 placed at predetermined axial locations  $x_1 - x_N$  disposed axially along the pipe 14. The pressure sensors 15 – 18 provide acoustic pressure signals  $P_1(t) -$

10  $P_N(t)$  to a signal processing unit 30 which determines the speed of sound  $a_{mix}$  propagating through of the process flow 12 flowing in the pipe 14. The pressure sensors are piezoelectric film sensors that are clamped onto the outer surface of the pipe at the respective axial location.

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